MONTHLY WEATHER REVIEW.

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INTRODUCTION.

This REVIEW for August, 1893, is based on reports from 3,087 regular and voluntary observers. These reports are classified as follows: 164 reports from Weather Bureau stations; 40 reports from United States Army post surgeons; 2,156 monthly reports from state weather service and voluntary observers; 32 reports from Canadian stations; 220 reports through the Southern Pacific Railway Company; 475 marine reports through the co-operation of the Hydrographic Office, Navy Department; marine reports through the "New York Herald Weather Service"; monthly reports from local services established in all states and territories; and international simultaneous observations. Trustworthy newspaper extracts and special reports have also been used.

The WEATHER REVIEW for this month has been prepared under the general editorial supervision of Prof. Cleveland Abbe.

CHARACTERISTICS OF THE WEATHER FOR AUGUST, 1893.

TEMPERATURE.

The month was warmer than normal in the middle Atlantic and New England states, the Lake region, and in Manitoba and Alberta; it was cooler than the average August along the middle Pacific coast and on the northeast slope of the Rocky Mountains. At Eastport, Me., and Manchester, N. H., the month was the warmest August on record, and at Keesees Ferry, Ark., Eureka Ranch, Kans., Grand Coteau, La., and Fort Reno, Okla., the coolest on record.

PRECIPITATION.

The rainfall was in excess over the greater part of the south Atlantic states. Although rainfalls of 20, 22, and 24 inches are reported from South Carolina, and although the average for that state is much in excess of the normal, yet the rainfall is not the largest on record, having been exceeded in 1885. The rainfall was deficient in the Mississippi and Ohio valleys and upper lake region.

LOCAL WIND STORMS.

The local storms of the month have been generally small and isolated, and of the character of gusts attending thunderstorms rather than tornadoes.

Hot winds, with temperatures of 104°, 108°, and 111°, have been reported from Montana.

HURRICANES.

Four hurricanes have approached the coast of the United States from the Atlantic Ocean, and after curving northeastward have continued on toward Europe.

The first of these appeared on the 15th at latitude 33° N., longitude 60° W.; passed north of the Bermudas; recurved at latitude 37° 5′, and touched Newfoundland on the 18th.

The second passed near Saint Thomas and Puerto Rico on the 16th; recurved at latitude 32° 5′, longitude 75°; touched Cape Hatteras and Cape Cod on the 21st.

The third was at latitude 22°, longitude 63°, on the 20th; recurved at latitude 35°, longitude 75°; passed near Cape Hatteras and Atlantic City and over New York City on the 24th; and thence to the mouth of the Saint Lawrence. Much destruction was done on the middle Atlantic coast.

The fourth was at latitude 23°, longitude 67°, on the 24th; recurved at latitude 35°, longitude 81°, in North Carolina, and passed over Newfoundland on the 30th. This storm did much destruction in the south Atlantic states. Its center passed over or near Jacksonville, Savannah, Charleston, Augusta, Charlotte, Lynchburg, Harrisburg, Ithaca, Oswego, Northfield, and Saint John, N. B. The destruction to property on shore may be estimated as approximately $3,000,000. The loss of human life, nearly 2,000, was due principally to drowning by high water on the coast.

DROUGHT.

The injurious drought of July continued to the middle of August, and had generally lasted from eight to eleven weeks before it was broken by rains in the middle of August in the following states: Kentucky, Illinois, Indiana, Ohio, Michigan, and Missouri.

AURORAS.

During the night of the 6th auroral displays were noted generally over the northern and north-central parts of the country from New England to the north Pacific coast.

ATMOSPHERIC PRESSURE (expressed in inches and hundredths).

The distribution of mean atmospheric pressure for August, 1893, as determined from observations taken daily at 8 a. m. and 8 p. m. (75th meridian time), is shown on Chart II by isobars.

Chart V exhibits the normal distribution of atmospheric pressure and normal wind movement by Lambert's formula over the United States for August, and has been prepared by Prof. H. A. Hazen, who has also prepared all the others of this series, preliminary to the publication by the Weather Bureau of specially prepared data and charts showing the meteorological and climatic features and conditions of the United States. The pressures for the United States are reduced to sea-level by Prof. Hazen's methods and formulæ, those for Canada are reduced by Prof. Carpmael's method.

As compared with the preceding month of July, the mean pressures for August, 1893, are lower in the south Atlantic and Gulf states, but higher over New England and the Gulf of

Saint Lawrence; also higher over the Lake region but lower in northern California, Washington, and Oregon.

As compared with the normal for August, the pressures for August, 1893, have been lower in all the Atlantic States, as also on the Pacific coast, but showing only slight variations for the rest of the United States.

HIGH AND LOW AREAS

The paths of the centers of high and low areas moving over the United States and Canada during August, 1893, are traced on Charts IV and I, respectively, and their principal characteristics are given in the following text and table:

HIGH AREAS.

I.—At 8 a. m. of the 1st this high area extended from Texas to Ontario, being central in Iowa; that afternoon and subsequent day its area was greatly extended; on the morning of the 2d it was central near Port Huron, Mich., on the 3d in Connecticut, where it remained until 8 a. m. of the 4th.

II.—Appeared 8 a. m. of the 2d off the coast of Washington where on the 3d pressure rose to 30.10, but soon again declined.

III.—Appeared 8 a. m. of the 5th in Manitoba, moving southward between low areas I and II. Central at 8 a. m. of the 6th over Lake Superior; 7th, in Lower Michigan; 8th, on Lake Erie; 9th, in Pennsylvania; 10th, in Maryland; 11th, on the south Atlantic coast.

IV.—The morning chart of the 6th shows a high pressure area on the Pacific coast, following low area II; the pressure rose on the 7th, but rapidly declined. A large area of cold air, with occasional frost, the first of the season at New Salem, N. Dak., moved eastward, and at 8 a. m. of the 11th was central in the Dakotas; 12th, in Iowa; 13th, over Lake Huron; 14th, over Lake Ontario; 15th, extended from New York to Georgia. The first heavy frost of the season occurred on the 11th at New Salem, N. Dak.; on the 12th at Cross, S. Dak.; on the 13th at Cheboygan, Mich.; on the 14th at East Templeton, Mass.; 15th, at Blooming Grove, Pa.

V.—On the morning of the 13th the pressure began to rise rapidly in Oregon and Washington, where it was highest the morning of the 14th, but rapidly declined, while an area of clear, cold weather and frost moved eastward into Wyoming and disappeared by the 17th. The first heavy frost of the season occurred on the 16th at Lander, Wyo.

VI.—The morning chart of the 19th shows high pressure on Lake Superior, which extended southward to the Ohio Valley by the 21st, the center still remaining over the upper lakes, while the hurricane, low area VIII, moved along the coast of New England. On the morning of the 22d this high area was central in western New York, and subsequently, while low area IX was moving along the middle Atlantic coast, this high area was re-inforced by a decided rise of pressure over the Canadian Maritime Provinces, so that at 8 p. m. of the 22d the center of high pressure was over Connecticut; at 8 a. m. of the 23d over Maine; at 8 p. m. of the 23d over the Bay of Fundy; and at 8 a. m. of the 24th over Cape Breton.

VII.—On the 24th the pressure began to rise in British Columbia and at 8 a. m. of the 26th the area of high pressure was central in that region, and soon covered a very large area. (The first heavy frost occurred on the 25th, at Vernonia, Oregon.) 27th, 8 a. m., pressure was highest in Assiniboia, while a ridge extended from Kansas northwestward over and beyond Alberta, and frosts were reported that morning in Montana and the next morning (28th) in northern Nebraska (first of the season at Ewing, Nebr.), North and South Dakota, and western Minnesota (first frost at Fairmont, Minn., and on the morning of the 29th at Omaha, Nebr.).

On the 29th, 8 a. m., the high pressure extended from northern Texas to Minnesota and beyond, so that the ridge trended north-northeast, showing that the northern end of the ridge had moved eastward much more rapidly than the southern end, in accordance with the general principle that the movements of areas of high pressure, like those of low pressure, have only a general, or secondary, dependence on the surface winds and are more directly dependent on the circulation, or other movements, of the atmosphere at or above the level of the clouds. While this ridge of high pressure thus lay parallel to the Mississippi Valley, and a little to the west of it, and while its northerly winds, with clear, dry, cool weather were rapidly extending southward to the Gulf, the hurricane center, low area X, was rapidly moving from South Carolina to New York. Heavy frost at Black River Falls, Wis.; Saint Charles, Rushford, Hokah, Plainview, Carlton, and Long Prairie, Minn.; Hay Springs, Nebr.; Fayette, Iowa; Logansport, Ind.; Watertown, S. Dak.

The morning map of the 30th shows that the hurricane had passed rapidly to the Gulf of Saint Lawrence and clear weather, with high pressure, was then prevailing everywhere west of New Brunswick; light frosts were reported in Michigan at Allegan, Berrien Springs, and Grand Haven, at Galena, Ill., and Rock Rapids, Iowa; the central pressure was highest in Iowa. Nearly the same conditions prevailed on the morning of the 31st, when the highest pressure was still central in Iowa, while the northerly winds, still flowing southward into the Gulf of Mexico, were apparently contributing to the development of a whirlwind in that region. The great area covered by this high pressure, and by its outflowing winds, although both the pressure and the winds were moderate, makes it credible that the total energy represented by the movements within the high area was greater than the energy manifested by the more intense disturbances and destructive winds of the hurricane itself.

VIII. An area of high pressure on the north or preceding side of the hurricane, low area VIII, began to develop on the 26th over the Middle and Eastern States and Canadian Provinces. Its center appears over the Bay of Fundy at 8 a. m. of the 27th, and was some distance off the east Atlantic coast at 8 a. m. of the 28th. Possibly this area represented a horizontal flow of air and a temporary extension landward of the high pressure prevailing over the Atlantic, but the motions of the winds and clouds are not sufficient to establish this hypothesis.

LOW AREAS.

I.—Appeared in British Columbia and Washington on the morning of the 1st, and disappeared over the Gulf of Saint Lawrence on the afternoon of the 5th; the center remained always on the northern border of the daily weather map.

II.—Appeared in British Columbia on the afternoon of the 4th, and after descending southward in a very irregular manner, appeared on the morning of the 8th as an ill-defined trough of low pressure stretching from Kansas northeastward over and beyond Minnesota, after which it disappeared from our maps; at this time it was apparently the southerly branch of low area III.

III.—Appeared on the 8th in Saskatchewan. On the 9th it rapidly stretched southward into Dakota, but returned to Ontario on the 10th, and moving eastward, passed over Maine and Nova Scotia on the 13th. The southward extension on the 9th was apparently due to mechanical causes similar to the southward extension of low area II over that same territory on the preceding day.

IV. Appeared in British Columbia on the 11th and moved southeastward on the 13th and 14th until it had passed over to Manitoba, where it formed a well-defined center of low pressure. On the morning of the 15th it was central over Lake Winnipeg, after which it disappeared. The slight depression, low area V, that formed on the 14th in Kansas is to be considered as independent of the present one, and especially due to the southward flow of air from the high barometer then advancing from the Pacific coast.

VI.—The morning chart of the 16th shows a depression extending from the interior of California northward into British Columbia. From the latter region an indefinite low area moved southeastward; it apparently filled up on the 18th and 19th only to reappear on the 20th and 21st, and the center may be located in Dakota on the morning of the 22d, whence it moved northeastward, and on the 23d turned south to Lake Superior. Leaving the latter on the 24th it disappeared in Ontario, or may possibly have merged with low area VIII.

VII.—This depression first appears on the morning chart of the 17th, when it was central near Cape Breton, but a report from Bermuda dated 4 p. m., 15th, had shown that an Atlantic hurricane was then moving northward between that station and Halifax.

VIII.—This hurricane was first announced by a special dispatch from the observer at Saint Thomas, W. I., on the morning of the 16th, at which time the center was south of that island. The center subsequently passed over Puerto Rico, its track lay midway between the Bahamas and Bermuda, touching Cape Hatteras on the 20th, Cape Cod on the 21st, central over the Bay of Fundy on the 21st, 8 p. m., and thence northeastward over Newfoundland. Subsequent reports trace this hurricane back to the 15th near Martinique, and it probably belongs to the class that are initiated by the flow of dry air northeastward from Venezuela and Guiana into the equatorial region of rain.

As soon as the first dispatch was received from Saint Thomas, a special bulletin, dated 3.30 p. m., 16th, announced:

It is probable that a so-called West India hurricane is moving westward and is about to cross the 65th meridian. The normal track of hurricanes for August would require this to recurve by Monday next (21st) before reaching the south Atlantic coast. Vessels leaving New York for New Orleans should secure sea room by keeping well out from the shore, that is, east of the Gulf Stream. Vessels leaving Gulf ports should obtain the latest telegram from the Weather Bureau observer at Key West.

On the morning of the 18th there were some indications at our south Atlantic coast stations of the presence of this storm-center, although it was then 500 or 600 miles distant, and on the 19th indications of its approach still demonstrated its very considerable distance northeast of Nassau. The general forecast at 8 p. m. of that date states:

The hurricane that was near Saint Thomas on Wednesday is now (Saturday night) apparently central about latitude 30° and longitude 72°, having reached the point of curvature northward. It may, therefore, not strike the south Atlantic coast with much severity. Vessels leaving New York for Bermuda may meet this storm on Monday.

Heavy rain prevailed during Sunday night and Monday on the middle and east Atlantic coasts. The forecast of 8 p. m. Sunday states:

The hurricane center will probably move northeastward by Monday night, after touching the North Carolina coast, and cross latitude 40° on Tuesday (22d).

But actually the center now began to move very rapidly and reached the Bay of Fundy by 8 p. m. Monday, 21st. The maximum wind was: Block Island, ne., 72; Woods Holl, ne., 60; Boston, ne., 30; Eastport, ne., 46.

IX.—On the 21st the northerly winds in the rear of low area VII extended over Florida and the eastern portion of the Gulf of Mexico, where pressure still remained below the normal, and an ill-defined area of low pressure prevailed over that region, apparently moving slowly eastward. The indications of the formation of the storm-center were noted in the general synopsis of 8 p. m., 21st, but it seems to have first begun developing rapidly on the 22d over the Gulf Stream east of the south Atlantic coast.

The storm that was felt at Cape Hatteras the morning of the 23d is now known to have come from latitude 23°, longitude 64° on August 20th, and latitude 14°, longitude 42° on August 16th as a well-defined hurricane that advanced over the mid-ocean without being recognized as such at the West Indian stations. Therefore, its remarkable growth and track until it reached New York, N. Y., were not well foreseen, and were at once checked by the overpowering influence of the land. The path of the center appears to have been northward, passing within less than 100 miles of Cape Hatteras, and then quite exactly over Atlantic City, N. J., and New York, N. Y., at which latter place it was central on the morning of the 24th. After this, the central low pressures rapidly filled up, the winds and rain diminished as the center moved northward through New Hampshire to the mouth of the Saint Lawrence, where it disappeared on the morning of the 25th.

At 2 p. m., 24th, the following special bulletin was issued:

The storm whose center passed over New York early Thursday morning was not heralded from the West Indies, but the map of Monday evening showed a possible storm-cepter in process of formation, and it is quite probable that this resulted on Tuesday morning in a depression located from 300 to 500 miles east of Florida. At that time high pressure, with northeast winds, prevailed in the middle and south Atlantic states. The whirlwind thus formed then moved north, keeping to the east of Cape Hatteras on Wednesday morning and to the east of the Virginia capes on Wednesday evening, but drawing closer in shore and increasing in intensity, developing lower pressure and higher winds by the time it struck the New Jersey coast and eventually New York. Northeast gales of 52 miles occurred at Atlantic City and 56 miles at New York, shifting suddenly to southwest between midnight and 6 a. m. this morning. No reports have been received from the New England coast, where easterly gales have probably been experienced. At last accounts the storm-center had passed from the ocean on to the land and was traversing southern New England, a route which is quite unusual and will probably facilitate the breaking up of the storm.

X.—The weather map of the morning of August 25th (Friday), not only showed the disappearance of low area IX in Labrador, but also stated that "there are indications of a hurricane-center about 500 miles southeast of Florida, moving toward the northwest;" subsequent reports indicated that the center was then far north of Turks Island, possibly near latitude 25°, instead of being near that island as was at first thought. Marine reports for the 22d show very low pressure and high winds at latitude 22°, longitude 57°, suggesting that the hurricane was even then at a stage of full development. If the approximate track of the center be traced back to latitude 18°, longitude 20° on the 15th (at which time an area of high pressure was central in Germany and extended south over the Sahara), then it becomes plausible that this hurricane belongs to a class that is initiated by the flow of dry air from North African plateaus westward to the ocean.

Special dispatches on the afternoon of Friday (25th) showed that the heavy waves which extend outward in all directions from a hurricane center were already noticeable at Savannah, and probably all along the south Atlantic coast. Storm signals were at once displayed from Savannah to Wilmington, and northeast gales, with rain, predicted for Saturday; both gales and rain reached these signal stations on Sunday, so that, technically speaking, the warnings were somewhat premature, but considering the indefiniteness of our knowledge as to the location of the center of the hurricane, it was doubtless the best that could be done. The center passed 100 miles northeast of Nassau, Saturday morning the 26th, and the general forecast of that date states that:

The track of the hurricane will probably keep to the west of the two preceding tracks and bring more rain to the interior of the Atlantic States.

The special bulletin issued on the afternoon of the same date states:

The hurricane indicated in the general synopsis of 8 a. m. Friday morning as probably existing about 500 miles southeast of Florida has apparently moved west-northwest, and early this morning passed to the north of but near Nassau, in the Bahamas, where high winds prevailed all night, and at 8 a. m. the wind was brisk northwest, with the barometer at 29.56. The course of this storm-center has thus far lain to the westward of its two predecessors, and, as frequently is the case, it should therefore strike the Atlantic coast at a point farther south than did the hurricane of Wednesday last. The heavy ocean swell preceding the storm was reported Friday morning at Savannah. Northeasterly gales and general rains are indicated for Saturday night and Sunday on the coast of the south Atlantic states, including the west coast of the Florida Peninsula.

The Secretaries of the Maritime Exchanges in New York and Philadelphia and the observers at Breakwater, Baltimore, Norfolk, Boston, New York, and Philadelphia were informed

that the storm existing off the coast rendered it unsafe for vessels to leave port for the South until further notice from the Weather Bureau, as dangerous gales were likely to occur during the next forty-eight hours. The observers were notified to be prompt in giving this information to shipping interests.

On the 26th, at 8 p. m., the storm then being central northeast of Jupiter Inlet, it became safe to predict:

The hurricane center will probably strike the coast of the south Atlantic states on Sunday, pass inward, and break up into general rains on Monday.

This prediction of course assumed that the hurricane would not recurve and keep off the south Atlantic coast, and was based partly upon the little knowledge we already had as to its past course and partly upon the distribution of pressure, winds, and clouds then prevailing in the Atlantic States and Lake region, all of which favored the westward motion of the hurricane. This prediction, and the reasoning which led to it, were confirmed by the appearance of the map of Sunday morning (27th), and the general forecast of that date said:

The low center off the Florida coast will move northwest, striking the coast of Georgia Sunday evening or night, and passing inward break up into general rains over the Appalachian Mountains.

The center passed very nearly over Jacksonville and Savannah, and then inward very near to Augusta, which latter point it reached about 6 a. m. of Monday, 28th.

On Sunday special noon reports were called for from stations in the vicinity of the storm's path, and based on these reports a dispatch was sent to the President, then on the New England coast, informing him that dangerous gales prevailed on the south Atlantic coast, that the storm would extend northward and be felt on the middle Atlantic and southern New England coasts on Monday night, and that the northern ports had been warned that it was unsafe for vessels to leave port.

The forecast of 8 p. m., Sunday, although telegraphic reports were missing from Charleston to Key West, ventured on the prediction:

It will move northward over Savannah between Charleston and Augusta into North Carolina. There are indications of its breaking up in that region Monday afternoon.

These indications consisted especially in the fact that the winds which were blowing from the Atlantic coast toward the Appalachians, and those which were blowing from the Lake region, Mississippi, and Ohio valleys also toward the Appalachians, would probably produce two or more extended areas of cloud and rain, such that the heat of Monday's sunshine would spread the isobars apart and break up the storm into two areas of low pressure, one over the lower lakes and the other on the middle Atlantic coast. As the event proved, however, the dispersion thus produced was not sufficient to divide the storm as a whole, and it passed over the Appalachians between 8 p. m. of the 28th and 8 a. m. of Tuesday, 29th, when it was central in the northern part of New York.

The tendency to the formation of a new area of low pressure over the lower lake region (or rather on the western slope of the Appalachians when northerly winds prevail in that region) is almost invariably exhibited when hurricanes prevail on the Atlantic coast, and as a consequence the latter in their journey from Florida toward New Jersey are often divided and sometimes pass entirely over the western side of that range; or again, having reached New Jersey the center is retarded in its progress eastward, and may even break up over New England. These are all illustrations of the general principle that among the features controlling the motion of a cyclonic storm, one of the most important is the location of the area of formation of cloud and rain.

The strong influence of the northeast winds that were about to prevail over the lower lakes (and actually did arrive about between 3 and 8 p. m. on Monday) was anticipated Monday morning, when the weather map showed the storm-center near Augusta, and a trough of low pressure running northward into Canada, while an area of high pressure had steadily advanced southeastward into the upper Mississippi and lower Missouri valleys with cold, dry, northerly winds already prevailing over the upper lakes. The general forecast of Monday morning states:

The hurricane center will probably move north-northeast, keeping east of the Appalachian range, and producing high southeasterly winds backing to northeasterly on the middle Atlantic coast, with general rain in the middle Atlantic states.

A due north-northeast course would have carried the storm center to Oswego, and it would seem likely that after passing more nearly northward, as though it were actually about to cross over to the Lake region, the center then turned a little more to the east and was moving northeastward on the morning of Tuesday, 29th, when it was about 50 miles southeast of Oswego, while the rain areas extended farther to the west, viz., Toledo, than to the east, namely, Boston.

At 3 p. m. of Monday, the 28th, the hurricane center was a few miles northwest of Charlotte, having moved slowly since 8 a. m., but the longer axis of the oval isobars now pointed northward and the center assumed a much more rapid movement. In the afternoon the observers at Atlantic City, New Brunswick, Philadelphia, New York, New Haven, and New London were wired that severe easterly gales, heavy rains, and unusually high tides were indicated for the middle Atlantic and south New England coasts Monday night; they were also instructed to give this information to the public and to telegraph it to any postmaster on the coast where the public might be benefited.

To the postmasters at Cape May, Asbury Park, Sea Isle City, Wildewood, Beach Haven, and Barnegat City telegrams were sent giving similar information, and requesting that said information be given to the public. On the receipt of these telegrams the newspapers in some of these cities issued extra editions in order to disseminate the information, and letters of thanks were afterwards received from the Boards of Trade and public officials, acknowledging the great value of the warning.

The Secretaries of the Maritime Exchanges of New York and Philadelphia, and officials of the Baltimore and Ohio and Pennsylvania railroads in Philadelphia and Baltimore, were notified of the anticipated severity of the storm on the Atlantic coast, and observers at Raleigh, Lynchburg, Charlotte, Norfolk, Harrisburg, Baltimore, and the Chamber of Commerce at Richmond were informed that the rains attending the storm were likely to cause dangerous floods. At 8 p. m. so many observations were missing, owing to the interruption of telegraphic communication, that it was not practicable to make any general prediction of the future course of the hurricane center other than those already made as to its general northeasterly course; but at that moment it was actually raining, with northeast winds, over the whole of West Virginia, western Pennsylvania, western New York, and northeastern Ohio, which condition shows how strong was the tendency toward the formation of low barometer on the west side of that mountain range, while on the south and east sides it was raining, with southeasterly winds, only in a narrow belt from Raleigh to Lynchburg and Washington; the motion of the clouds showed that at that moment the movement of air over the Atlantic States was from the southwest and therefore not tending to especially increase the rainfall, either as to intensity, area, or quantity, and a similar condition prevailed on the west side of the Appalachians, except only over Lake Ontario.

The map at 8 a. m. Tuesday, 29th, was practically blank, as telegraphic communication was cut off in all directions. But the subsequent reports show that the center was at that moment near Oswego, having moved at the remarkable rate of 450 miles in twelve hours, and the elongated isobars suggest that within that interval a long trough of low pressure had been formed, stretching from Lynchburg to Oswego, and that the isobars of 8 a. m., 29th, represent the rapid filling up of the southern end of that trough and the transfer of the

storm-center from Lynchburg to Oswego rather than the movement of a well-defined whirlwind at a rapid rate over this mountainous country. The isobars and winds of Tuesday morning show that we have no longer to do with a symmetrical revolving hurricane, but with two, if not three, systems of winds blowing into the region of low pressure and each striving to set up its own independent whirl, namely, southerly winds from New Jersey to Massachusetts, westerly winds in Pennsylvania, and northeasterly winds in Vermont, the Saint Lawrence Valley, and Lake Ontario. Although, as before stated, the weather map was a blank north and west of Maryland and Virginia, yet it was evident that the storm-center had now rapidly passed northward of Maryland; by prediction it should be at least as far north as the boundary between New York and Pennsylvania, and the following general synopsis and forecast was ventured:

The hurricane is probably central in Pennsylvania. The storm-center will move northeast through New York state into the Saint Lawrence Valley.

The map for 8 p. m., 29th, shows that the center was then a little east of Quebec, and possibly within the border of Maine, having moved about 350 miles or more within twelve hours; the isobars now exhibit the great elongation characteristic of the breaking up of a storm. The general conditions and forecast read as follows:

The central calm area has become a long oval, with southwesterly winds on its east side from Massachusetts to the Gulf of Saint Lawrence, and northeasterly winds on its west side at Canadian stations. The current wind velocities average about one-half of those prevailing Monday night. The storm will probably move northeast to Labrador, and may possibly become again powerful after reaching the Atlantic.

The text on the map of 8 a. m. Wednesday, 30th, states that:

The hurricane has moved northeastward down the Saint Lawrence Valley and is now central near the mouth of that river.

Subsequent marine reports do not show the presence of any special storm-center east of Labrador and Newfoundland, and it is probable that this powerful whirl was broken up as such on the 1st of September.

XI.—While the preceding, low area X, was on the 28th passing from Augusta to Lynchburg, the northerly winds and dry air in the Mississippi Valley and the Southwest extended rapidly southward over the Gulf. We have as yet no evidence of the existence therein of any low barometer and cyclonic winds on Monday, but the moderate norther of Monday in the western Gulf, combined with the southerly winds in the eastern Gulf, favored the formation of a moderate barometric depression in the central Gulf which seemed to have prevailed without any general progressive movement from that time until 8 p. m. of the 31st. During these three days the pressure at Port Eads was generally lower than at New Orleans or Mobile, and the tendency toward local and general storms was daily manifest. At one time it was thought that a hurricane would evolve itself out of this indefinite condition, and accordingly at 8 p. m. of the 30th storm-warning signals were displayed from Port Eads eastward to Savannah, but no general storm resulted, although local gusts, waterspouts, and thunderstorms were reported. These conditions continued over into September.

XII.—On the 24th, 8 a. m., a depression apparently existed in northern Alberta, although in fact there was a general depression along a large portion of the Rocky Mountain and Pacific coast regions. The map for 8 p. m. locates a central depression in southern Alberta. This depression stretched southward over California, Mexico, and Texas, although its center continued moving eastward along our northern border. On the 27th, at 8 p. m., it was central between James Bay and Lake Huron, while the hurricane, low area X, was on the coast of Georgia. The subsequent path of that hurricane carried it northward rapidly, and it may be said to have become united with the present low area by 8 a. m. of the 29th. It would, however, be a mistake to speak of this junction as an illustration of the tendency of two cyclones to run into each other and unite. It would seem more proper rather to consider the present indefinite depression, low area XII, as a valley between the two high areas that were on the 27th central over the Rocky Mountain plateau and Nova Scotia, respectively. The movement of low area X was controlled by the nature of the air supplied to it from these two areas of high pressure.

XIII. An indefinite area of low pressure appears on the afternoon of the 30th in Assiniboia and Saskatchewan, by the morning of the 31st it was north of Lake Superior, and its further development belongs to September.

Movements of areas of high and low pressures.

Number.	First observed.			Last observed.			Path.		Average velocities.	
	Date.	Lat. N.	Long. W.	Date.	Lat. N.	Long. W.	Length.	Duration.	Daily.	Hourly.
High areas.		°	°		°	°	*Miles.*	*Days.*	*Miles.*	*Miles.*
I										
II										
III	5, a. m.	51	94	11, a. m.	31	80	1,700	6.0	280	11.7
IV	6, a. m.	47	127	15, a. m.	43	76	2,700	9.0	300	12.5
V										
VI	19, a. m.	44	86	23, a. m.	46	61	1,600	4.0	400	16.7
VII	24, a. m.	50	127	31, a. m.	43	92	2,200	7.0	315	13.1
Mean								6.5	324	13.5
Low areas.										
I	1, a. m.	51	121	5, p. m.	49	67	2,600	4.5	578	24.1
II	4, p. m.	53	120	8, a. m.	48	96	1,400	4.0	350	14.6
III	8, a. m.	55	110	13, p. m.	45	62	2,600	5.5	473	19.7
IV										
V	14, p. m.	39	101	18, p. m.	41	72	1,600	4.0	400	16.6
VI	17, a. m.	52	121	24, p. m.	46	83	2,900	7.5	399	16.6
VII	15, a. m.	33	60	17, p. m.	43	56	1,000	2.5	400	16.6
VIII	16, a. m.	16	65	22, a. m.	48	60	2,700	6.0	450	18.8
IX	21, p. m.	29	85	25, a. m.	50	65	2,400	3.5	699	25.0
X	22, a. m.	23	58	30, a. m.	48	63	3,300	8.0	413	17.2
XI										
Mean								5.1	462	19.9

NORTH ATLANTIC STORMS FOR AUGUST, 1893.

[*Pressure in inches and millimeters; wind-force by Beaufort scale.*]

The paths of storms that passed over the western portion of the north Atlantic Ocean are shown on Chart I, so far as can be traced from information received up to the 25th of September, through the co-operation of the Hydrographic Office and the "New York Herald Weather Service."

The normal pressure for August over the north Atlantic Ocean, as shown by the international simultaneous meteorological observations, is highest, 30.20 (767), in an oval extending from W. 24°, N. 37° to W. 48°, N. 32°; pressure is lowest, 29.70 (754), in a small oval north of Iceland and a second small oval at the northwestern extremity of Baffins Bay.

As compared with July the mean pressure for the current August is higher on the east Atlantic coast, as also in northern Greenland and the extreme northern part of the Atlantic Ocean. The pressure is lower throughout the eastern part of the Atlantic Ocean.

The tracks of storm-centers for August in their passage from the east Atlantic coast toward the coasts of Great Britain and Norway have an average velocity of about 23 statute miles per hour, but the velocity of those moving from the West Indies toward the south Atlantic coast is about 18 miles. The tracks of storms for August may be classified as (I) those which pass up the Gulf Stream over Newfoundland, north of Scotland over Norway and the Gulf of Finland into